4. Though transitionals obscure limiting lines in dead material, species exist in young stocks and the actual limits of each are such as it makes for itself by the general interbreeding of its constituents under normal conditions.

5. The normal self-observed limits of species in nature among young stocks must be worked out on the merits of each case by the study of living material through all its stages with relation to its environment.

6. As a basis for this work all recognizable forms in young stocks must be described, named and regarded as tentative species until their status is finally determined.

7. All recognizable forms in young stocks demand a name and final place in the taxonomic system down to race rank, and none should be lost sight of by lumping of names.

8. Isolated or aberrant transitionals need no distinctive name, but as a matter of record they should be descriptively differentiated from that form which they most closely approach.

9. It follows that the describing and naming of forms in young stocks should be based on as large series as possible.

Notes on the Thoracic Sclerites of Winged Insects.*

By G. C. Crampton, Ph.D.

(Plate III.)

As used by most anatomists, the term *dorsum* is applied to the entire upper or dorsal surface of an insect's body; the entire side, or lateral portion of the body is termed the *latus;* and the entire lower or ventral surface is termed the *venter.* To avoid confusion, these terms should be used in this sense alone.

The entire dorsal region of each segment (i. e. the more membranous, as well as the more strongly chitinized portions of the body wall) is termed the *tergum,* or *notum;* the entire lateral region of each segment is termed the *pleuron* (both flanks being termed the *pleura*); and the entire ventral region

*Contribution from the Entomological Laboratory of the Massachusetts Agricultural College, Amherst, Mass.

of each segment is termed the *sternum*. The sclerites (either distinct plates, or subdivisions of the more strongly chitinized regions marked off by sutures) of the tergum are called *tergites;* those of the pleural region are called *pleurites;* and those of the sternal region are termed *sternites*. Unless confusion is to continue to reign in the terminology applied to the thoracic sclerites we must hold rigidly to the simple and logical usage given above.

From the study of the larval forms of insects, and the more primitive representatives of the order, it would appear that the thoracic sclerites were originally formed as numerous plates formed by depositions of pigment and chitin, due (in all probability) to the stimulus of muscular tension, and to other mechanical stimuli, such as friction. As specialization progresses, there is a marked tendency for these originally distinct plates to unite, or fuse together; and by the breaking up into parts (*derivatives*) of the original plates, by the re-combination of these parts fusing with other sclerites, and by the formation of secondary sutures (i. e. those not originally present), the modifications of the original typical or "ground-plan" met with in the different orders of insects, are brought about.

The hypothetical "ground-plan" of thorax shown in Plate III, Fig. 2, is more of a composite, or combination of the possible conditions met with in different winged insects, than an attempted reconstruction of the original condition found in the ancestors of these insects. It nevertheless approaches the original condition, in many respects. The plates which were originally separate and distinct are, for the most part, so represented in the figure. The greater part of the sutures originally present, or those early formed, are designated by heavy lines; while those added as later modifications (i. e. secondary sutures), are indicated by dotted lines. Although the types of thoracic sclerites represented in the following series do not cover all of the conditions met with in winged insects, it is a comparatively simple matter to reduce any of them to some one of the types here represented. The principal sclerites of the tergal, pleural and sternal regions may be briefly described as follows:

TERGITES—There are two principal plates found in the tergal region of winged insects. These are the *scutoscutellum,* or large anterior plate *Scsl* (Fig. 2), and the *postscutellum,* or smaller posterior plate *Psl. The* scutoscutellum bears the wing, or the wing articulates with its lateral margin. The postscutellum is not connected with the wing in any insects thus far observed. In some insects the scutoscutellum is connected with the pleural region by a pre-alar bridge, or connecting sclerite *Pal* (Figs. 2 and 5), extending in front of the wing; while the postscutellum is usually connected with the pleural region by a post-alar bridge *Plph* (Fig. 2), extending behind the wing.

There frequently occur *"implexes"* (i. e., any in-folding, or in-pocketing of the integument) which serve the double purpose of affording better attachment for the muscles, and of strengthening, or rendering more rigid, the sclerites in which they occur. The outward manifestation of such an "implex," or internal fold, is an external groove or suture, formed by the meeting of the external lips of the fold. Naturally, these folds, or plaits, are composed of two plates. These may be so closely applied to each other as to appear as a single plate. Both plates may be equally strongly chitinized, or one may be strongly chitinized and the other membranous.

The transverse "implexes" of the tergal region are termed *phragmas,* and these occur at the dividing line between two consecutive segments, so that the anterior plate of the phragma may be considered to belong to the segment in front, and the posterior one to the segment behind. If the anterior plate of the two which make the phragma is strongly chitinized while the other is membranous, the phragma appears to belong entirely to the segment in front. If the posterior one is strongly chitinized, while the other is membranous, the phragma appears to belong to the segment behind. The anterior plate of the tergal region (i. e., the scutoscutellum, mentioned above) may bear a phragma at its anterior margin, or the posterior tergal plate (i. e., the postscutellum) may bear a phragma along its posterior margin.

The anterior tergal plate *Scsl* (Fig. 2) may be further di-

vided by sutures (with, or without corresponding internal folds) into a number of subregions, or subdivisions. The foremost of these is a narrow, transverse region, the *pretergite, Am* (Figs. 2, 4, 5 and 6), lateral to which is the *prealare, Pal* (Figs. 2, 4 and 5). Behind the region *Am* is the *prescutum, Psc* (Figs. 2, 4, 5 and 6). Following the prescutum is the *scutum, Sc* (Figs. 2, 4, 5 and 6). Situated somewhat anteriorly and laterally to the scutum is a narrow sclerite, the *supraalare, At* (Figs. 2, 4, 5 and 6), with which the wing veins articulate by means of a small movable, or articulatory plate, the *notopterale, Npt* (Figs. 2, 4, 5 and 6). (These articulatory plates by means of which the wing veins articulate with the tergal plate, have been recently termed the *pteralia*). Situated in the incision between the sclerites *Pal* and *At,* is the *tegula,* or *parapteron, Tg* (Figs. 2, 4, 5 and 6). The scutum, *Sc,* may be divided into subregions by the formation of sutures, or even a transverse fissure. The principal subdivision is the *juxtascutellum, Jsl* (Fig. 2) situated on either side of the *scutellum, Sl* (Figs. 2, 4, 5 and 6). The sclerite *Jsl* is not marked off in the insects figured in the series here given, but occurs in the Diptera and Hymenoptera. An articulatory extension of the scutum, termed the *anal pterale, Scpt* (Fig. 2), becomes detached in the higher insects, and forms one of the pteralia mentioned above. A narrow, posterior, marginal sclerite, the *postergite, Pm* (Figs. 2, 4, 5 and 6) is the hindmost of the subdivisions of the tergal plate *Scsl.* It sometimes occurs as a posteriorly-projecting, fold-like region of this plate. A median dorsal suture (with its corresponding internal fold, or "implex") called the mid-dorsal suture may partially divide the tergal plate into symmetrical halves.

The posterior tergal plate, or postscutellum *Psl* (Figs. 2, 4 and 5), is not connected with the wing, but is usually connected with the pleural region in the higher insects, as was mentioned above. The postscutellum consists of an external region (the "phragmite") and an internal portion, the phragma. The external region of the postscutellum, in some insects is divided into a median region, the *"mediophragmite," Mph*

(Fig. 2), and a lateral portion (one on either side), the *pleurophragmite, Plph* (Fig. 2). These are best seen in the Diptera and Odonata. The postscutellar plates *Psl* (Fig. 6) of the cockroach, doubtless are the representatives of the postscutellum in other insects.

The various subdivisions of the tergal plates described above, are not met with in all insects, those usually present being the prescutum (*Psc*), the scutum (*Sc*), the scutellum (*Sl*), and the postscutellum (*Psl*).

The small tergal plates, or *intertergites, It* (Fig. 4) occurring in front of the anterior tergal plate in such insects as *Corydalis*, are doubtless homologous with the dorsal cervical sclerites *It* (Fig. 3) occurring in front of the pronotum of the cockroach and other insects. These will be discussed under the consideration of the intersegmental sclerites.

Pleurites—Situated immediately below the wing is a subalar plate, the *subalare, Asa* (Figs. 2, 4, 5 and 6). There are sometimes two of these, an anterior and posterior subalare, *Asa* and *Psa* (Fig. 5), but only the anterior one is large enough to be of any importance. The principal plate of the pleural region is the *eupleurite,* composed of the regions *Em, Es* and *Lpl* (Figs. 1 and 2). This was in all probability a single plate originally, but later became divided into a number of sub-regions by the formation of sutures. A more or less oblique infolding of the integument whose external manifestation in the pleural suture *g* (of all figures) extends from the top of this plate to the bottom of it. Internally, an "implex" or ridge called the *pleural ridge,* or *apodeme,* likewise extends from top to bottom on the inner surface of the plate. The region immediately posterior to the pleural suture *g,* is the *epimeron, Em* (in all figures). The epimeron may be subdivided into an upper and a lower region *Ppl* and *Hem* (Figs. 2 and 4) in such insects as *Mantispa, Chrysopa,* etc., but this is of somewhat rare occurrence.

The region immediately anterior to the pleural suture *g* is the *episternum, Es* (in all figures). In the mesothorax of the earwig, the formation of a second suture *e* (Fig. 1) marks off the *lateropleurite, Lpl,* from the remainder of the pleural plate.

A lateral plate of the sternal region, the *laterosternite, Lst* (Fig. 1) may become detached from the sternal region and unite with the sclerite *Lpl* (Fig. 1) to form a pre-coxal bridge *Lat* (Fig. 3) extending in front of the coxa, and connecting the pleural with the sternal region. This pre-coxal bridge may then be divided by a suture *b* (Fig. 3) into an anterior region, the *precoxale, Pcx* (Fig. 1) and a narrow posterior region, the *antecoxale,* or "antecoxal piece" of recent writers, *Acx* (Figs. 3 and 6). The precoxal bridge, however, is usually indistinguishably united with the episternum above, and with the sternum below, in the higher insects.

A secondary suture *d* (Figs. 2, 4, 5 and 6) marks off an upper region, or *anepisternum, Aes,* in the dorsal region of the pleural plate, and this small region is usually mistaken for the episternum in such cases, although the episternum *always extends from the top to the bottom of the pleural plate.* Two small "derivatives" of the region *Aes,* at the base of the wing, may be more or less completely detached from this region to form the anterior and posterior *basalare,* or basalar plates, *Aba* and *Pba* (Figs. 2, 4, 5 and 6).

The triangular plate termed the *trochantin, Tn* (Figs. 1, 2 and 6) may possibly be a detached sclerite of the pleural plate, although it is regarded by some writers as a detached portion of the coxa. The trochantin may be divided by an oblique suture into an anterior and posterior region as in Fig. 6 (*Tn*); it may be divided into two distinct plates as in Fig. 1 (*Tn*) by splitting up obliquely; or it may split up transversely into two distinct plates as in Fig. 3. The smaller of the two plates is the *trochantinelle, Tnl* (Fig. 3). The dorsal portion of the trochantin may unite with the pleural plate, and by a continuation of the suture *b* (Fig. 2) a composite region, the *pleurotrochantin, Ptn* (Fig. 4) is formed. This is not to be considered as the trochantin alone, as is done by most writers.

There occurs in some insects, a post-coxal sclerite, the *postcoxale, Poc* (Fig. 2) which may unite with the lower portion of the epimeron and with the sternite *Fs* to form a post-coxal bridge *Poc* (Fig. 4) connecting the pleural with the sternal region. There may thus be a pre-coxal and a post-coxal bridge connecting the pleural and sternal regions.

In front of the pleural plate, there occur, in some insects, a small group of plates, the *interpleurites, Ip* (Figs. 2, 3 and 4) which will be discussed with the remainder of the intersegmental plates under the heading intersegmentalia. In addition to these may be mentioned the *peritreme, Pt* (Figs. 1, 2, 4, 5 and 6), which surrounds the spiracle or breathing pore. The spiracle is regarded by many investigators as belonging to the segment behind it.

Sternites—In such primitive insects as the stoneflies *Capnia* and *Leuctra,* there are five distinct sclerites in the sternal region, and traces of certain of these sternites are preserved in some insects, although the most of them disappear in the higher forms, either through fusion with each other, or through a fading out of the pigment and the softening of the chitinous deposits which formed them.

The sternite which is tentatively designated as the foremost of the principal sternal sclerites, is the *prebasisternite, Pbs* (Figs. 2, 3 and 5), which is probably a derivative (or detached portion) of the large sternite behind it, called the *basisternite, Bs* (Figs. 1, 2, 3, 4, 5 and 6). The basisternite, as the name implies, forms the lower portion of the sternum in many insects; its lateral wings *Lst,* previously described, forming the sternal portion of the flanks. These lateral extensions may become detached to form separate plates, the *laterosternites, Lst* (Fig. 1) as in the earwig, or they may remain connected with the sternum, and unite with the pleural plate to form a pre-coxal bridge extending between the pleural and sternal regions. The basisternite may be split up by diagonal fissures, into four sclerites, as in the prothorax of the roach *Ectobia* (Fig. 3, *Bs*). The basisternite is retained in practically all insects, and forms the principal sclerite of the sternal region.

Behind the basisternite is the *furcasternite, Fs* (Figs. 1, 2, 3, 4, 5 and 6). As the name implies, it bears the *furca,* or fork-like *apophyses* (internal sternal processes). The apophyses may be separated from each other, one on either side of the median ventral line (i. e., *diapophyses*), or they may approach each other in the median line, and their bases unite,

while their distal extremities remain separated to form the arms of the fork.

Following the furcasternite is the *postfurcasternite, Pfs* (Figs. 2 and 5), and behind this is the *spinasternite, Ss* (Figs. 1, 2, 3, 4, 5 and 6), so called because it bears the *spina,* or unpaired median apophysis (*monapophysis*). It has not yet been determined whether or not the spinasternite is the foremost or the hindmost of the sternites, but it is here treated as though it were the hindmost.

The internal projections of the sternal region are termed *apophyses.* In order to distinguish the paired from the unpaired apophyses, the terms *diapophyses* and *monapophysis* may be used to designate the two types.

A median ventral fold, the mid-ventral "implex," with its corresponding external suture, frequently partly divides the sternal sclerites into symmetrical halves. It, however, is absent in many insects.

All of the sternites mentioned above are not preserved in the higher insects, the two usually represented being the basisternite and the furcasternite (called the antecoxal piece by the older writers). The prebasisternite is retained in the prothorax of certain lower forms, and two derivatives, or detached portions, of this region occur as narrow transverse plates, the *intersternites, Is* (Figs. 2 and 3), in the prosternum of the earwig and roach.

Intersegmentalia—The term *intersegmental plates,* or *intersegmentalia* is applied to the small sclerites situated between the segments. These plates, in all probability, belong partly to the segment in front of them, partly to the segment behind them, and are therefore not to be considered as vestiges of reduced segments in the process of becoming lost.

The dorsal intersegmentals are the *intertergites, It* (Figs. 2, 3 and 4). They occur in front of the mesonotum of *Corydalis* (Fig. 4, *It*) and in front of the pronotum of the roach (Fig. 3, *It*). Those in front of the pronotum are called the dorsal cervicals (*cervicalia*). The dorsal intersegmentals are probably detached plates belonging to the segment in front of them.

The lateral intersegmentals are the *interpleurites, Ip* (Figs. 2, 3, 4 and 5), and the postcoxale, *Poc* (Fig. 4) might possibly be likewise included under the designation lateral intersegmentals. There are two well developed interpleurites in front of the pleuron of the mesothorax in *Corydalis*. The posterior one is much the larger, and probably belongs to the segment behind it, while the anterior one may belong to the segment in front. The anterior interpleurite in this insect bears an internal process for muscle attachment. The interpleurites *Ip* (Fig. 3) in front of the pleuron of the prothorax in the roach, are called the *lateral cervicals.*

The ventral intersegmentals are the prebasisternite *Pbs* (Figs. 2, 3 and 5), the intersternites, *Is* (Figs. 2 and 3), and possibly the spinasternite, *Ss* (Figs. 2, 3 and 5). The prebasisternum and intersternites, *Pbs* and *Is* (Fig. 3) in front of the prosternum of the roach, earwig, etc., are termed the *ventral cervicals.* All of these sternites appear to be parts of the segment behind them.

It is thus apparent that the cervical sclerites (cervicalia) are in all probability homologous with the intersegmental sclerites (intersegmentalia) in front of the other thoracic sclerites, and these doubtless belong partly to the segment behind them, partly to the segment in front. It is thus as incorrect to regard the cervical sclerites as representing the entire labial segment, as it would be to regard the intersegmental sclerites in front of the metathorax as representing the entire mesothoracic segment; for these intersegmental (and cervical) sclerites belong partly to the segment behind them, partly to the segment in front, as we have seen.

The region containing the cervical sclerites is the *veracervix*, or *"cervicum."* It would be simpler to designate this region as the cervix, since it is the true neck region, but the term cervix is always applied to the constricted occipital region of the head; on this account the "manufactured" term "cervicum," or the compound term veracervix is preferable. The function of the neck region is to enable the head to turn more readily.

EXPLANATION OF PLATE III.

Fig. 1. Mesothorax of the earwig *Forficula.*

Fig. 2. "Ground plan" of typical thoracic segment.

Fig. 3. Prothorax of roach. Pleural region as in *Periplaneta;* sternal region as in *Ectobia.*

Fig. 4. Mesothorax of *Corydalis.*

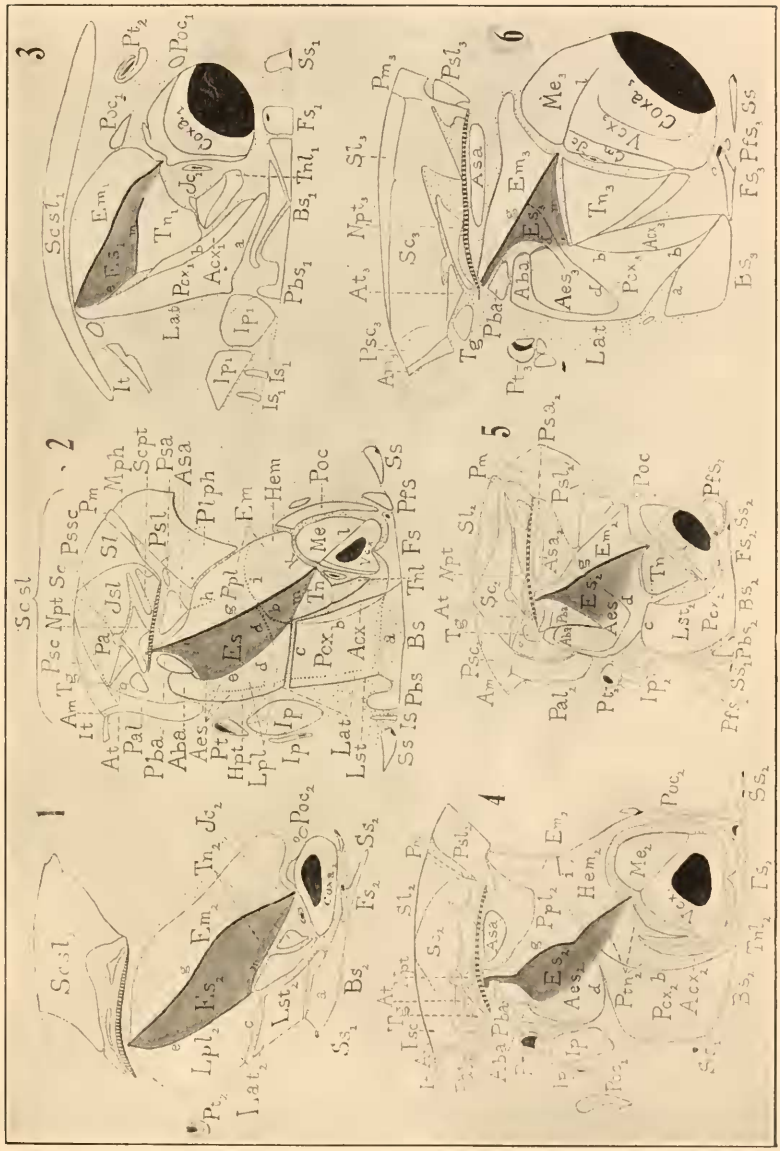
Fig. 5. Mesothorax of stonefly. Pleural region as in *Perla;* sternal region as in *Capnia* and *Leuctra.*

Fig. 6. Metathorax of roach. Pleural region as in *Ischnoptera* (male); sternal region as in mesothorax of *Periplaneta.*

All figures are so oriented that the dorsal region is directed toward the top of the page, and the anterior portion toward the left hand margin, the plate being held sidewise to read the abbreviations. All show lateral views. The coxae are partly cut off in all figures. Black areas denote cavities, or the location of internal processes.

a, Suture betweeen basisternite (Bs) and laterosternite (Lst).
Aba, Anterior basalare.
Acx, Antecoxale.
Aes, Anepisternum.
Am, Pretergite.
Asa, Anterior subalare.
At, Supraalare.
b, Suture between antecoxale (Acx) and precoxale (Pcx).
Bs, Basisternite.
c, Suture betweeen laterosternite (Lst) and lateropleurite (Lpl).
Cm, Coxamarginale.
d, Suture marking off anepisternum (Aes).
e, Suture between episternum (Es) and lateropleurite (Lpl).
Em, Epimeron.
Es, Episternum.
Fs, Furcasternite.
g, Pleural suture (between episternum and epimeron).
h, Suture below subalar sclerite (Asa).
Hem, Hypoepimeron.
Hpt, Hypopteron.
i, Suture dividing epimeron (Em) into upper and lower regions.
Ip, Interpleurites.
Is, Intersternites.
It, Intertergites.
Jc, Juxtacoxale.
Jsl, Juxtascutellum.
k, Suture between epimeron (Em) and meron (Me).
l, Meral suture (between meron and anterior portion of coxa).
Lat, Laterale.
Lpl, Lateropleurite.
Lst, Laterosternite.
m, Suture between episternum (Es) and trochantin (Tn).
Mc, Meron.*
Mph, Mediophragmite.
Npt, Notopterale.
Pal, Prealare.
Pba, Posterior basalare.

* In the Diptera, the term *meropleurite* is applied to the meron united with the lower portion of the epimeron.



THORACIC SCLERITES OF WINGED INSECTS—CRAMPTON.